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EMBEDDING MATERIALS FOR MODULAR ASSEMBLIES: A PARTIALLY ANNOTATED BIBLIOGRAPHY

SPECIAL BIBLIOGRAPHY
SB-62-64

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EMBEDDING MATERIALS FOR MODULAR ASSEMBLIES: A PARTIALLY ANNOTATED BIBLIOGRAPHY

Compiled by

C. M. PIERCE

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Lockheed

MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE, CALIFORNIA

NOTICE

ABSTRACT

Modular packaging of electronics assemblies is a means of enhancing the dependability of equipment which is designed to operate in extreme environments. The proper selection of a plastic embedding material for a particular situation is, therefore, an important aspect in the design of dependable modules. The primary purpose of this bibliography is that of providing information on materials which can be utilized for the embedment of electronics assemblies.

References are arranged alphabetically by author. Separate indexes for corporate author, secondary author, and subject are included at the end of the bibliography. The period of coverage dates from 1950 through June 1962.

Search completed August 1962.

Availability notices and procurement instructions following the citations are direct quotations of such instructions appearing in the source material announcing that report. The compiler is well aware that many of these agencies' names, addresses and office codes will have changed; however, no attempt has been made to update each of these notices individually.

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This selective bibliography has been prepared in response to a specific request and is confined to the limits of that request. No claim is made that this is an exhaustive or critical compilation. The inclusion of any reference to material is not to be construed as an endorsement of the information contained in that material.

TABLE OF CONTENTS

5. Axelrood, S. L. and K. C. Firisch
Cast urethane elastomers from polypropylene glycols. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137th ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. (Sponsored by: The American Chemical Society) Washington, D. C., 1960. v. 20, p. 173.

6. Axelrood, S. L. and K. C. Frisch
Cast urethane elastomers from polypropylene glycols. RUBBER AGE 88:465–471, Dec 1960

A discussion of various method for increasing the hardness of the casting elastomers and the effects imparted on other physical properties.

7. Barnstoff, H. D., et al.
A unique modifier for epoxy resins. SOC. PLASTICS ENG. 15:10, Oct 1959.

The authors describe a new additive for epoxy resins.

8. Barr, F. A. and J. P. McCarthy
DEVELOPMENT OF ULTRA HIGH TEMPERATURE DIELECTRIC MATERIALS FOR EMBEDDING AND ENCAPSULATING ELECTRONIC COMPONENTS. Synthetic Mica Corp., Clifton, N. J., Quarterly progress rept. no. 3, 17 Nov 60–16 Feb 1961. 19p. AD-266 1961

The porosity of the standard aluminum phosphate – synthetic mica composition was decreased by forming by dry pressing. Water absorption values averaged as low as 12%. A dry pressed lead borate synthetic mica system exhibited average water absorption percentages as low as 8%. Additions of lead borate to a slurry of the regular phosphate bonded synthetic mica resulted in cast samples with a decrease in

1. Aitken, I. D. and K. Ralph
SOME EFFECTS OF RADIATION IN CAST EPOXIDE RESIN SYSTEMS. Atomic Energy Research Establishment, Harwell, England Rept. no. AERE-R-3085, Feb 1960.

Changes in the flexural strength due to pile irradiation of cast epoxide resin systems have been measured. The effect of various types of curing agent on the rate of breakdown is shown.

2. Ankward, J. A., R. W. Warfield, and M. C. Petree
THE CHANGE IN ELECTRICAL RESISTIVITY OF SOME HIGH POLYMERS DURING ISOTHERMAL POLYMERIZATION. NAVORD Report 4421, Nov 1956. (Also in J. POLYMER SCI. 27:199–205, 1958.)

3. Applegath, D. C.
Epoxy resins in thermosetting acrylics. In PROCEEDINGS OF THE DIVISION OF ORGANIC COATINGS AND PLASTICS CHEMISTRY, 138th ACS MEETING, NEW YORK, 11–16 SEP 1960. (Sponsored by: The American Chemical Society) Washington, D. C., The Society, 1960. v. 20, p. 338.

4. Athey, R. J.
Liquid Urethane Elastomers. RUBBER AGE 85:77–81, Apr 1959.

5. Axelrood, S. L. and K. C. Firisch
Cast urethane elastomers from polypropylene glycols. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137th ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. (Sponsored by: The American Chemical Society) Washington, D. C., 1960. v. 20, p. 173.

6. Axelrood, S. L. and K. C. Frisch
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8. Barr, F. A. and J. P. McCarthy
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The porosity of the standard aluminum phosphate – synthetic mica composition was decreased by forming by dry pressing. Water absorption values averaged as low as 12%. A dry pressed lead borate synthetic mica system exhibited average water absorption percentages as low as 8%. Additions of lead borate to a slurry of the regular phosphate bonded synthetic mica resulted in cast samples with a decrease in

porosity of approximately 45%. No suitable methods of impregnating porous samples were developed. Both pressure and vacuum techniques produced samples difficult to cure. A study of phosphate bonded alumina indicated that such a system might be advantageous for incorporation into the basic formulation.

9. Barr, F. A. and J. P. McCarthy
DEVELOPMENT OF ULTRA HIGH TEMPER ATURE DIELECTRIC MATERIALS FOR EMBEDDING AND ENCAPSULATING ELECTRONIC COMPONENTS. Synthetic Mica Corp., Clifton, N. J., Final rept., 16 May 1960–16 May 1961. 54p. ASTIA AD-265 499

Phosphate synthetic mica was investigated as a dielectric material for encapsulating and embedding electronic components for 500 C use. Physical properties of the system were determined and found to be suitable for high temperature use. Various methods of reducing porosity were investigated including dry pressing; glass coating, additives and various phosphate bonds. The use of a devitrified glass sealing cement as a coating for the phosphate synthetic mica resulted in a composite material cured below 500 C, having good physical properties with water absorption less than 1%. Commercial capacitors, transformers, and motors were encapsulated and tested. Prototype high temperature resistors were constructed and encapsulated for 500°C applications using ceramo-plastic injection molding techniques in combination with the phosphate-mica dielectric material.

10. Beccasio, A. J.
CONFORMAL COATINGS FOR PRINTED CIRCUIT ASSEMBLIES. Motorola, Inc., Chicago, Ill. Quarterly rept. no. 2, 1 Nov 1961–30 Jan 1962. 6Cp. ASTIA AD-273 080

Contents:
Epoxy resin coating systems
- Physical and electrical properties: Dielectric constant, dissipation factor and Q factor of the disc specimens; Q factor and dissipation factor of the coated test panels; Thermal cycling; Dielectric withstanding voltage; Insulation resistance under moisture conditions

Polyurethane resin coating systems
  Physical and electrical properties: Dielectric constant, dissipation factor and Q factor of the disc specimens; Q factor and dissipation factor of the coated test panels; Thermal cycling; Dielectric withstanding voltage; Insulation resistance under moisture conditions

Silicone-based polymer coatings
  Characteristics of coating systems
  Test panels used
  Precoating preparation of surface
  Physical and electrical properties

11. Benderly, A. Tidler, J. and Greene, B. Protective potting of glass vacuum tubes and ceramic components. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24—25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. 1956. p.13. ASTIA AD-102 048. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

12. Boivin, J. L. THE MECHANISM OF THE CROSS-LINKING OF THE URETHANE FUNCTION AND THE ADDITIONAL CROSS-LINKING INDUCED BY SHORT CHAIN DIOLS IN POLYURETHANE ELASTOMERS. Canadian Armament Research and Development Establishment. (CARDE Technical memo. no. 196/58, 15 Jul 1958. 7p. (Encl. 45 to Air Attache, Ottawa, rept. no. TL 71-58) ASTIA AD-203 546.

Evidence has been obtained that cross-linking of the urethane functions by isocyanate groups does not take place in solvent polymerization. The additional cross-links induced by short chain diols are caused by dimerization of 2,4-tolylene disocyanate.

The dimer behaves like a tri-functional compound by ring opening to form gels at temperatures below 95°C and linear polymers at temperatures above 120°C or at 150°C in dimethylformamide solution.

13. Bolin, R. E. and Burck, R. C.
Properties of commercial and new solid urethane elastomers. In SEALANTS AND SEALING OF AIRCRAFT MISSILES, AND ELECTRICAL COMPONENTS, LOS ANGELES, CALIF., 28–30 OCT 1959. Society of Aircraft Materials and Process Engineers. SAMPE Symposium Paper no. 7, 1959. 14p.

14. Bolson, H. B.
Optimum curing conditions for solid epoxy resins determined by statistical evaluation. In PROCEEDINGS OF THE DIVISION OF ORGANIC COATINGS AND PLASTICS CHEMISTRY, 138th ACS MEETING, NEW YORK, 11–16 SEP 1960. Washington, D. C., The American Chemical Society, 1960. v. 20, p. 350.

15. Brenner, W., Lum, D., and Riley, M. W.
HIGH TEMPERATURE PLASTICS. N. Y., Reinhold, 1961. 231p.

One section of the book is devoted to the epoxies.

16. Breslau, A. and Cranker, K.
Polysulfide liquid polymer and modified epoxy resin casting compound. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories. Washington, D. C. ASTIA AD-102 048. 1956. p. 107. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

17. Briggs, J. L. and Calicchia, R.
Encapsulating techniques for electronics equipment. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 1. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

18. Brown, C. O.
EMBEDDING RESINS FOR B/D MK 9 COMPONENTS; STUDY OF. Naval Ordnance Plant, Indianapolis, Ind. Informal report. Working paper W-55-29, 22 Dec 1959. 19p. ASTIA AD-82 447.

A resin is being developed for embedding and impregnating toroidal coils. Epoxy-type base resins and various hardeners and fillers were evaluated to develop a low-viscosity mixture which would penetrate the coil windings. The physical and electrical characteristics are tabulated for the resin compositions. Compositions with allyl glycidyl ether or Cardolite were discarded because of excessively high coefficients of thermal expansion. Zeroplast gave the lowest coefficient of thermal expansion. Embedment with a composition of Shell 828, piperidine, and Zeroplast resulted in electrical changes which could not be compensated. A dibutylamine and Zeroplast composition appeared promising. Results showed that toroidal coils can be successfully impregnated and embedded in a filled epoxy resin with a one-step process if suitable compensation is made for electrical changes. The compensation is achieved by a winding around the periphery of the coil after impregnation and necessitates a 2-step process. The use of a 2-step process presents no additional problems in selecting the proper casting resin. Components can be secured to a printed circuit board by mounting them

close to the board and securing them against shock and vibration by means of an epoxy resin applied by dipping or brushing, with a resultant saving in space in comparison with the use of component clips.

19. Brown, C. O.
EMBEDDING RESINS FOR B/D MK 9 COMPONENTS: STUDY OF. Naval Ordnance Plant, Indianapolis, Ind. Final rept. Materials rept. no. 44, 1 Jun 1956, 18p. ASTIA AD-99 534.

A study was made of embedding and encapsulating resins for use in various applications encountered in the development of the B/D MK 9 system at the Naval Ordnance Test Station, China Lake, California. A number of epoxy resin formulations were developed with which toroidal coils were successfully impregnated and embedded. Physical and electrical properties of these materials were determined. One formulation was adopted by NOTS on the basis of practical performance tests. Four epoxy resin formulations were used to anchor components to printed circuit boards, which successfully passed vibration tests at NOTS. None of these were adopted for use, since it was decided at NOTS that a catacomb would be used to hold the components. A re-evaluation of filler materials was made from the standpoint of thermal conductivity of the resins. Of the filler materials which were usable from the standpoint of viscosity of the mixtures, the one with the highest thermal conductivity was recommended, although it was only slightly better in that respect than the one previously adopted for use by NOTS. Recommendations based on laboratory evaluations were made for formulations which merited final evaluation by performance tests in equipment in which they are to be used.

20. Brown, C. O.
EMBEDDING RESINS FOR USE IN ELECTRO-MECHANICAL COMPONENTS AT TEMPERATURES OVER 200°C. Naval Avionics Facility, Indianapolis, Ind. Materials rept. no. 55, 27 Aug 1958. 10p. ASTIA AD-202 346.

Electrical and physical properties were determined for the formulations described in a previous NAFI Materials Report (no. 51), and for further modifications of these formulations. The best all-round formulation, G118-30, was taken to the plant of the John Oster Corporation and there used to embed twenty-two (22) Servo Motors, MK-7. These motors were specially made with high-temperature resistant materials throughout and will be tested at NAFI by operating at an ambient temperature of 500°F until failure results. A number of formulations were prepared, attempting to develop a

two-stage embedding resin, (organic-ceramic) which would sinter into a ceramic structure after the organic resin was decomposed by heat. The most promising filler material was found to be a ground frit. When this frit was used in an epoxy resin casting, the casting withstood exposure at 750°F with little change in shape and retained a considerable degree of hardness and strength, however porosity and discoloration were observed.

21. Brown, C.
Casting resin investigations at naval ordnance plant. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 54. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

22. Brydson, J A.
Selection of compounding ingredients. Soluability parameter as technology aid. PLASTICS 26:107–110, Dec 1961.

23. Buck, B. I.
Epoxide resins – a literature survey. BRIT. PLASTICS 32:475, Oct 1959.

A discussion of the current progress in the production and evaluation of curing agents. A bibliography covering applications, reactions, modified epoxide compounds, testing, plasticizers, and stabilizers is included.

24. Butler, J.
COMPRESSION AND TRANSFER MOLDING OF PLASTICS. N. Y., Interscience Publishers, 1960. 230p.

25. Calicchia, R.
ENCAPSULATION OF ELECTRONIC CIRCUITS.
Rome Air Development Center, Griffiss Air
Force Base, N. Y. Rept. no. RADC TR-58-8,
Jan 1958. 17p. ASTIA AD-148 557.

RADC is engaged in a program aimed at developing experimental design data for engineers confronted with problems of selecting proper encapsulents for electronic equipment. In particular, it is intended to indicate the quantitative effects of the encapsulating dielectric upon the electrical characteristics of the embedment. Of jamor interest is the work initiated on the electrical performance of resistors, capacitors, inductors, and simple circuits, at frequencies up to 240 megacycles. The investigation of the electrical and mechanical properties of various resins was necessary in order that the most suitable encapsulent be selected.

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Curing resins suitable for embedding electronic
components by irradiation. In SYMPOSIUM ON
CASTING RESINS, WASHINGTON, D. C.,
24–25 JAN 1956. Diamond Ordnance Fuze
Laboratories, Washington, D. C. ASTIA
AD-102 048. 1956. p.170. (Also in:
ELECTRONICS EQUIPMENT, Jul 1956.)

27. Carr, B. and Vasileff, N.
CASTOR OIL POLYURETHANES AND APPLICATIONS
AS POTTING COMPOUNDS. Princeton University
Plastics Laboratory. Technical rept. no. 14 D,
Jun 1949.

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TRANSPARENT COLD-SHOCK-RESISTANT
EPOXY CASTING RESINS. Sandia Corporation,
Albuquerque, N. M. SCR-173, May 1960.

29. Carroll, K. W.
Vary the catalyst to vary epoxies' bonding properties.
PLASTICS TECHNOLOGY 7:52–54, Jun 1961.

Data is given on a wide range of properties which can be obtained from various combinations of hardeners with one epoxy adhesive. The hot strength, peel strength, solvent resistance, and pot life of different combinations are discussed.

30. Cassias, G., Cristiansen, R. E. and Trifan, D. S.
CASTOR OIL-M-TOLYLENE DIISOCYANATE POLYURETHANE RESINS AND RELATED MODIFICATIONS AS POTTING COMPOUNDS.
Princeton University Plastics Laboratory,
Technical rept. no. 26C, 25 Jul 1952.

31. CASTING RESINS. Squier Signal Lab., Signal Corps Engineering Labs., Fort Monmouth, N. J.
Information bull. no. 152, 1952. 7p.
ASTIA AD-167.

32. Chakoumakos, C. and Emerson, C. L., Jr.
DEVELOPMENT OF AN INORGANIC FOAMED-IN-PLACE MATERIAL. Emerson and Cuming, Inc., Canton, Mass. Progress rept. no. 10, 6 Jan 1954. 7p.
ASTIA AD-45 559.

Simple open-mold techiques were employed in the use of phenolic resins as the base resins in an inorganic-reinforced organic resin foam. General Electric's phenolic foam resin and Standard Silica Company's inorganic reinforcing agent Ultra Blackhawk Sand were used; Bakelite catalyst and foaming agent were used. The inorganic-reinforced phenolic resin foams which were produced are more heat resistance and unicellular than similar foams produced from polyester and epoxide resins. Ultra Blackhawk Sand was superior to Firefrax 1-DF in producing reinforced phenolic resin foams of reasonable uniformity. Unicellularity improvements of 8 to 10 lb/cu ft will be investigated by closed-mold techniques.

33. Chambers, R. E. and McGarry, F. J.
Resin shrinkage pressures during cure. In TECHNICAL AND MANAGEMENT CONFERENCE, 14 ANNUAL, CHICAGO, ILL., 3–5 FEB 1959. Chicago, Society of the Plastics Industry, 1959.

34. Childers, S. and Allinkov, S.
DEVELOPMENT OF A NON-ADHERING CHEMICALLY FOAMED-IN-PLACE CUSHIONING MATERIAL FOR PACKAGING PURPOSES. Materials Lab., Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. WADC Tech Report 57-682, Jan 1958. ASTIA AD-142 282.

35. Childers, S.
MATERIALS, TECHNIQUES AND ECONOMICS OF FOAMED-IN-PLACE POLYURETHANE CUSHIONING FOR PACKAGING. Materials Lab., Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. WADC technical rept. no. 58-601, Apr 1959.

36. Chiola, V., et al.
CASTOR OIL-DIISOCYANATE POLYURETHANE AS IMPREGNATING, ENCAPSULATING, AND POTTING COMPOUND. Plastics Laboratory, Princeton University. Technical rept. no. 21B, 21 Jun 1951.

37. Christensen, D. F. and R. L. Spraetz
THE EVALUATION OF SOME SILICONE AND ORGANIC ENCAPSULANTS AND POTTING COMPOUNDS BY POTTED CAPACITORS.
Dow Corning Corporation. Product engineering rept. no. 1862, 15 Jun 1960.

38. Christensen, D. F.
Silicone encapsulants for electronic applications.
In APPLICATION OF ELECTRICAL INSULATION, 3RD ANNUAL NATIONAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p. 164.

39. Christie, H. and T. Medved
HIGH TEMPERATURE RESISTANT TRANSPARENT PLASTICS. Midwest Research Inst., Kansas City, Mo. Final rept. 15 Feb–14 Oct 1961. 31 Oct 1961. 63p. ASTIA AD-269 603.

Purification of the diglycidyl ether of bisphenol A (DEBA) by vacuum distillation and decolorization of the trimethoxyboroxine (TMB) catalyst produced colorless starting materials. Reaction of these materials produced a water-white resin. After curing in vacuum, the 0.26 in. thick castings had a luminous transmission of 88 percent. Small quantities of low color epoxy novolac resin were obtained by molecular distillation of a commercial product. The distillate reacted rapidly with TMB to form a hard solid with much lower color than obtained from any previous resin of this type. Cast resins obtained from hexahydrophthalic anhydride and vinylcyclohexene dioxide were extremely notch sensitive and brittle.

40. Christiansen, R. E. and D. S. Trifan
PLASTICIZED MODIFICATION OF DIPROPYLENE GLYCOL-CASTOR OIL-m-TOLYLENE DIISCOCYANATE POLYURETHANES AS POTTING RESINS. Plastics Laboratory, Princeton University. Technical rept. no. 13A, 30 Nov 1953.

41. Clark, C. G.
POTTING, EMBEDMENT, AND ENCAPSULATION OF WELDED ELECTRONIC CIRCUITS. Space Technology Labs., Los Angeles. Rept. no. STL/TR 60-0000-19354, Nov 1960. 48p.
(PB 155-755)

A wide variety of detailed information is given on methods, materials, and techniques for potting, embedment, and encapsulation of electronic circuits. A discussion of quality control is also included.

42. Cole, S. S. Jr., B. Litt, and L. Lamb
CERAMIC MICROMINIATURE TRANSISTOR PACKAGE. Mitronics, Inc., Murray Hill, N. J. Quarterly progress rept. no. 1, 1 Jul—30 Sep 1961. Technical note no. 1, Oct 1961. 20p
ASTIA AD-268 745.

Consideration was given to the use of steatite, forsterite, and A1203 as the most suitable ceramic materials for the microminiature transistor package. On the basis of comparative properties, ease of sealing and reliability, A1203 was chosen as the most desirable ceramic material. Kovar was chosen as the most satisfactory metal. Temporary tooling was procured and approximately 75 test packages were fabricated. Fabrication techniques produced satisfactory results. A quality control test was developed to insure continuing high quality. Three designs were studied, two of which show suitable promise for further extensive testing. Seventy-one test packages were produced for thermal dissipation and welding tests. Equipment and techniques were developed to evaluate welding processes and thermal dissipation. Tooling is complete for both types of evaluation.

43. Coleman, D. G.
RESEARCH IN ANC-17 HANDBOOK PLASTICS FOR FLIGHT VEHICLES. Forest Products Lab., Madison, Wis. Annual rept. for Jul 1960–Jul 1961 on rubber, plastics, and composite materials. Rept. no. WADC TR 52-183, Suppl. 9, Nov 1961. 4p. ASTIA AD-271 964.

Developments in the program of research in plastics for flight vehicles conducted by the U. S. Forest Products Laboratory are summarized. In general, the approach was to derive criteria mathematically, and then to check by test.

44. Colichman, E. L. and Strong, J. D.
Effect of gamma radiation on epoxy plastics. MODERN PLASTICS 36:180–186, Oct 1957.

The extent to which typical thermally cured epoxy plastics might be improved by radiation postcuring has been investigated. Nine different epoxy compositions were studied containing various curing agents and the presence or absence of reactive diluents. Gamma radiation dosages were 10^6, 10^7, and 10^8 roentgens. Physical properties measured on irradiated and unirradiated specimens were hardness, heat distortion temperatures, and compressive strengths.

45. Colichman, E. L. and Scarborough, J. M.
Radiation processing of unfilled polyester resins. JOURNAL OF APPLIED CHEMISTRY (LONDON) 8:219–223, Apr 1958.

Four commercially available, thermally cured polyester resins were subjected to gamma-irradiation at dosages of 1.0×10^6 to 5.0×10^7 rad, and the effects of the irradiations on physical properties were examined. The greatest effects were on tensile strength and Young's modulus in which 20 percent improvement was noted. There were no significant changes in hardness or heat distortion properties. Styrene-modified polyester syrups can be completely cured by irradiation at 5.0×10^6 to 1.0×10^7 rad, but the properties of the cured products are not significantly superior to those of materials cured by conventional procedures.

46. Comins, H. L.
TECHNICAL RESOURCES DIRECTORY IN PLASTICS. Plastic Technical Evaluation Center, Picatinny Arsenal, Dover, N. J. PLASTEC rept. no. 5, Jan 1961. (OTS PB 171 036)

47. Cook, P. J., Lanza, V. L. and Conde, J. S.
Encapsulation of electrical components using heat shrinkable, pre-molded parts. In APPLICATION OF ELECTRICAL INSULATION, 3RD ANNUAL NATIONAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p.162.

48. Cordaro, J. T.
STUDIES ON THE PREVENTION OF CONTAMINATION OF EXTRATERRESTRIAL BODIES. BACTERIOLOGIC EXAMINATION OF HERMETICALLY SEALED ELECTRONIC COMPONENTS. School of Aerospace Medicine, Brooks Air Force Base, Tex . Rept. no. 62-18, Nov 1961. 6p. ASTIA AD-272 334.

Bacteriologic technics to determine the existence of contamination in hermetically sealed electronic components were examined as well as those considered typical of being included in the electronic systems of spacecraft. Of the 166 components examined, 11 were contaminated. Paper and mylar-type capacitors were found more likely to be contaminated during fabrication than other types of capacitors examined. An approach for the development of procedures for the sterilization of electronic components is presented.

49. Dallett, D.
PLASTICS AND ADHESIVES. Naval Ordnance Test Station, China Lake, Calif. OTS rept. no. PB 131686, Oct 1956. 108p.

Guide to the physical properties and uses of plastics and adhesives.

50. Dannenberg, H.
Refractive index method for determining cure rates of epoxy resins. SOC. PLASTICS ENG. J. 15:875, Oct 1959.

Describes a method for testing the cure performance of epoxy resins and curing agents.

51. Davis, B. A.
Effects of temperature on filled epoxy encapsulation materials. SOC. PLASTICS ENG. J. 16:1333, Dec 1960.

A discussion of the benefits gained from the shielding of molds.

52. Davis, D. R.
Guide to materials selection. PLASTICS TECHNOLOGY 8:38–40, May 1962.

Information is given on 24 plastic molding materials. Properties such as mechanical, electrical, thermal, chemical resistance, optical clarity, and water absorptivity are demonstrated in tabular form.

53. Davis, T. R., Jr.
PREPARATION OF COMPOSITE TRANSPARENT PLASTIC SPECIMENTS. Aeronautical Materials Lab., Naval Air Material Center, Philadelphia, Pa. Final rept. Rept. no. NAMC AML 1312, 28 Nov 1961. 5p. ASTIA AD-271 186L

54. Delmonte, J.
METAL-FILLED PLASTICS. N. Y., Reinhold, 1961, 240p.

55. Delmonte, J.
Influence of metallic fillers on properties of plastics. In ELECTRICAL INSULATION, ANNUAL CONFERENCE REPORT, WASHINGTON, D. C., OCT 1960. Washington, D. C., Division of Engineering and Industrial Research, NAS-NRC. NAS-NRC Publ. 842, 1961. p. 191–194.

56. De Lollis, N.
Potting resins – functions and requirements. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.138. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

57. Dewey, G. and J. Outwater
Pressures on objects embedded in rigid cross-linked polymers. MODERN PLASTICS 37:142–205, Feb 1960.

The technique involves the modification of an ordinary glass thermometer for use as a "null" pressure transducer. The experimental findings agree with the theoretical estimates.

58. Dixon, L. A.
Epoxy insulation in new forms molding compound and machine stock. In APPLICATION OF ELECTRICAL INSULATION, THIRD ANNUAL NATIONAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p. 27.

59. Doctor, N. and P. Franklin
Corrosive effects of casting resins on bare copper wire. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 344. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

60. Doctor, N. J., Q. C. Kaiser, et al.
PROGRESS IN MINIATURIZATION AND MICROMINIATURIZATION (U). Diamond Ordnance Fuze Labs., Washington, D. C. Rept. for Apr–Jun 1961. DOFL rept. no. PR-61-8, 22 Dec 1961. 38p. ASTIA AD-327 823. CONFIDENTIAL REPORT

61. Dorfman, H.
ENCAPSULATION OF WELDED MODULES. Missiles and Space Div., Lockheed Aircraft Corp. Rept. no. MRI 270.02, Apr 1961. 25p.

Results are given of a program to investigate suitable encapsulants, evaluate various encapsulating processes and improve electronic reliability by use of conductive adhesive on weld joints.

62. Downs, F.
The cast plastic sealing of platinum-clad anodes for cathodic protection of submarine hulls. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 101. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

63. DuBois, J. H.
Resins for Electronics. PLASTICS WORLD 19:46, Jun 1961.

A short review of materials development and their applications.

64. Eden, H. A. K.
Plastics in the electronics industry. PLASTICA 13:1108, Nov 1960.

A discussion of the general principles of selecting a plastics material and an evaluation of its usefulness. Consideration is given to dimensional stability.

65. Ehlers, G. F. L.
CORRELATION BETWEEN STRUCTURE AND THERMAL STABILITY OF EPOXY RESINS. Materials Central, Wright Air Development Div., Wright-Patterson Air Force Base, Ohio. Rept. for May 1957–Mar 1958, on Non-Metallic and Composite Materials. WADD TR 60-700, Jul 1960. 14p. ASTIA AD-245 270L.

A basic epoxy resin from Bisphenol A, as well as a number of other di- and poly-epoxy resins of defined structure, were cured with equivalent amounts of various anhydrides, amines, phenols and catalysts. Weight loss of these resins was determined from periods

up to 200 hours at 230°C, also the Vicat heat distortion temperature was determined before and after several aging periods. Thermal stability, and heat softening were correlated with the structures of the synthesized resins. Rigid (aromatic) structures as well as high functionality of the reactants, or dense crosslinking were found to contribute to a high heat distortion. Anhydrides as curing agents were found to be more favorable in this respect than phenols and amines, because the reactivity towards epoxy as well as secondary hydroxyl groups resulted in higher crosslinking density. Comparison of the three types of curing agents indicated about equal stability of the -C-O-C and the -C-NH-C-linkage. Both were somewhat more stable than the ester linkage -C-O-C-C. Unexpected high heat softening points were obtained by using additives with one epoxy group and a double bond, such as dipenteneoxide, or curing agents, containing a double bond, such as maleic anhydride. The results obtained indicate that the double bonds apparently are polymerized due to the pressence of epoxy groups, resulting in additional crosslinking.

66. ELECTRICAL-MECHANICAL PLASTIC, HIGH AND LOW K-LOW LOSS MATERIAL, POTTING COMPOUNDS, DIELECTRIC STUDIES, AND RHEOLOGICAL STUDIES. Plastics Lab., Princeton Univ., N. J. Status rept. nc. 32 (Final) 1 Aug 1950–28 Feb 1954. Rept. no. 14, 31 Mar 1954. 17p. ASTIA AD-42 858.

A review is presented of the contract research from Aug 1, 1950 to Feb 28, 1954; status reports covering the final period from Nov 1, 1953 to Feb 28, 1954 are included.

67. Eller, S. A., A. A. Stein, and C. K. Chatten Foamed resilent materials and rubberized-hair for package cushioning applications. In ELASTOMER RESEARCH AND DEVELOPMENT, PROCEEDINGS OF THE SIXTH JOINT ARMY-NAVY-AIR FORCE CONFERENCE, BOSTON, MASS., 18–20 OCT 1960. J. C. Montermoso and F. R. Fisher, eds. (Sponsored by: U. S. Army Quartermaster Research and Engineering Command) ASTIA AD-250 916. p. 519–535.

68. Ephraim, S. N. and S. W. Street
A new self-extinghishing epoxy resin. In
TECHNICAL AND MANAGEMENT CONFERENCE,
PROCEEDINGS OF THE SIXTEENTH ANNUAL,
CHICAGO, ILL., FEB 1961. Chicago, The
Society of the Plastics Industry, Inc., 1961.
Sect. 1-C.

69. Epoxies enhance Tiros reliability. AIRCRAFT
MISSILES 4(6):57–59, Jun 1961.

A general survey of the applications of epoxies. Emphasis is placed on the construction of solar cell module boards.

70. Fairbanks, D. R.
Thermal considerations for plastic encapsulation
or coating in electronic product design.
IRE TRANSACTIONS ON PRODUCT ENGINEERING
AND PRODUCTION PEP-6:(1), 11–12, Mar 1962.

Cooling and maintenance of low-temperature parts are discussed.

71. Facey, R. and F. Turner
COMPARISON OF DAMPING PROPERTIES
(BOUNCE) AT 25°C –55°C, AND 125°C, OF
EIGHT FLEXIBLE ENCAPSULATING MATERIALS.
Motorola, Inc., Scottsdale, Ariz. Test memo.
no. 626 (LD). 26 Aug 1961. 3p. (IDEP rept. no.
501.82.00. 10-S4-02) ASTIA AD-271 207.

The Sidewinder modules were designed to utilize an encapsulating materials with good vibrational damping properties. To study this property, a brief economical bounce test was constructed to compare various materials. The test specimens were dropped to the floor from a height of 36 inches. The distance that each ball rebounded was measured and recorded. The test was performed with the specimens stabilized at room temperature, and immediately after removing the specimens from -55°C and 125°C.

72. Feuchtbaum, R. B., C. J. Bahun and J. B. Rust
DEVELOPMENT OF IMPROVED THERMAL SHOCK RESISTANT DIELECTRIC MATERIAL FOR EMBEDDING ELECTRONIC COMPONENTS.
Hughes Aircraft Co., Culver City, Calif.
Final rept. Rept. no. TM-688. 1 Jun 1961.
ASTIA AD-265 469.

Silane curing agents were found to be superior to peroxide curing agents in imparting high temperature properties to poly (vinyl) siloxane resins. The silicone resins, cured with silane, maintain their dielectric properties for longer than 3C0 hours at temperatures of 350°C. Peroxide-cured resins disintegrated under the identical test conditions. These resins pass the thermal shock requirements of MIL-I-16923 after exposure to 350°C for 300 hours. Ultrahigh filler loading with Al_2O_3 was shown to be very beneficial in improving the coefficient of thermal expansion and the thermal conductivity of the siloxane resins. Bimodular filler techniques are demonstrably the best in improving the physical and thermal properties of the silicone resins.

73. Feuer, S. S. and A. F. Torres
How laminating techniques affect corrosion resistance of reinforced-plastic metal treating equipment. WIRE AND WIRE PRODS. 37:224–227, 264, 265, Feb 1962.

A discussion of testing and evaluation. Consideration is given to plastic types, reinforcement fibers, equipment design, laminate structure, laminating techniques, and the uniformity of resin distribution and curing methods.

74. Fineman, M. F. and I. E. Puddington
Measurement of cure of some thermosetting resins.
CAN. J. RES. 25B:101–107, 1947.

75. Fisch, W. and W. Hofman
Reaction mechanism, chemical structures, and changes in properties during the curing of epoxy resins. PLASTICS TECHNOLOGY. 7:28–32, Aug 1961.

The correlation between the chemical composition of a cured epoxy resin and its physical properties is discussed. This includes a demonstration of the relationship between the curing temperature and the chemical structure of the cured epoxy. Lower shrinkages can be obtained by controlling the exothermic reaction during the curing process.

76. Fitzgerald, C., et al.
Epoxy-polybutadiene resins. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C. 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C., ASTIA AD-102 048. 1956. p. 188. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

77. Flack, R.
Problems encountered in the development of potted electronic devices for a specific ordnance application. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C. 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 30. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

78. Gamero, R. and G. M. Le Favre
Castable elastomers in cable design. In SEALANTS AND SEALING OF AIRCRAFT, MISSILES AND ELECTRICAL COMPONENTS, LOS ANGELES, CALIFORNIA, 28–30 OCT 1959. Society of Aircraft Materials and Process Engineers, 1959.

79. Gigliotti, M. E.
DESIGN CRITERIA FOR PLASTIC PACKAGE-CUSHIONING MATERIALS. Plastics Technical Evaluation Center, Picatinny Arsenal, Dover, N. J. Plastic rept. no. 4, Dec 1961. 122p.

Packages capable of protecting fragile items from shock must be purposefully designed to be practical, efficient, and economical. The general design theory of package cushioning is given, and testing under static loading and dynamic loading are discussed. Design concepts are evaluated, with advantages indicated for the use of acceleration vs static stress data. Design equations and sample problems are included. As support information, the stress properties of the principal plastic package-cushioning materials are given, as well as data on the effect of temperature and humidity. Specific uses of rigid and semirigid plastic foams in cushioning applications are indicated. The report contains a summarization of package-cushioning test programs at 6 laboratories, an extensive reference list, and a bibliography.

80. Gilmore, A. G.
Recent developments in resin-cast transformers. BRITISH COMMUNICATIONS AND ELECTRONICS 8:444–448, Jun 1961.

Details of early and recent developments in potted transformers and future projections are presented.

81. Goldman, J.
Silicone potting gel for high voltage power supplies. MISSILES AND DEVELOPMENT 5:96–99, Jun 1959.

Describes a new potting compound which is completely transparent, moisture resistant, with excellent thermal stability and conductivity, and having electrical properties similar to those of a high-grade silicone oil. The silicone resin, called XF 1-0067, has the consistency of a heavy gelatin. After curing it gels irreversibily.

82. Gray, J. R.
The epoxy resins. PROGRESSIVE PLASTICS p. 63, Sep 1961.

A review of materials and their properties.

83. Gray, J. R.
The epoxy resins. PROGRESSIVE PLASTICS
p. 47, Nov 1961.

A discussion of long-time loading, adhesives, and related topics.

84. Greenland, K. M.
Some aspects of research on thin solid films.
J. SCI. INSTR. 38:1–11, Jan 1961.

Information is included on encapsulations.

85. Greenspan, F. P. and C. W. Johnston
Oxiron resins – a series of new epoxy resins.
In TECHNICAL AND MANAGEMENT CONFERENCE,
PROCEEDINGS OF THE SIXTEENTH ANNUAL.
CHICAGO, ILL., FEB 1961. Chicago Society
of the Plastics Industry, Inc., 1961. Sect. 1A.

86. Hall, E. C. and R. J. Jansson
MINIATURE PACKAGING OF ELECTRONICS IN
THREE-DIMENSIONAL FORM. Instrumentation
Laboratory, Massachusetts Institute of Technology,
Cambridge, Mass. Rept. no. MIT IL E-823,
Jun 1959.

87. Halpern, B. D. and W. Karo
FUNGUS-RESISTANT ELASTOMER. (Assigned to
Borden Co.) U. S. Patent 2, 951, 830. 6 Sep 1960.

The compound is also resistant to heat, water, solvents, and fuels.

88. Hanson, W. M. and J. R. Tuzinski
Strain gauge evaluation of flexible epoxy resins.
In SECOND NATIONAL CONFERENCE ON THE APPLICATION OF ELECTRICAL INSULATION. TECHNICAL PAPERS, WASHINGTON, D. C., 7–11 DEC 1959. N. Y., American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1960. p. 129–132.

89. Hare, E. F.
A STUDY OF THE ENCAPSULATION OF HIGH ENERGY SUBSTANCES. National Cash Register Co., Dayton, Ohio. Interim rept. no. 1, 1 Apr 1959–31 Mar 1960, Jul 1960. 13p. ASTIA AD-242 673.

Means are being investigated whereby certain of the highly energetic liquid fuels or oxidizers can be converted into solid capsular devices. Consideration is to be given to (1) dispersion of the internal phase (either liquid or solid) to be encapsulated in a compatible dispersion medium, (2) deposition of a compatible polymeric wall material around this internal phase, (3) wall formation and/or hardening, (4) separation of the resulting capsules from the organic dispersion medium, and (5) some sort of post treatment of the polymer wall if required. Initial studies are concerned with polymer film permeability. The synthesis of several polymers was attempted, and the effect of several organo-metallic crosslinking agents was investigated on the permeability of various polymer films. Permeability data are included for polymethyl methacrylate, nitrocellulose, ethyl cellulose, Saran, Kel-F 800, Gelatin, natural and vulcanized rubber, paraffin, and polyvinyl acetate in He at 24°C and in H_2O at 30°C. Methods of liquid encapsulation are described.

90. Harper, C. A.
Equipment for embedment processes. MODERN PLASTICS 38:105, Apr 1961.

A review of systems which are available for mixing, metering, and dispensing resins.

91. Harper, C. A.
ELECTRONIC PACKAGING WITH RESINS.
N. Y., McGraw-Hill, 1961. 339p.

Over 100 tables are included which give data on resin properties, trade names and suppliers, schedules for curing agents, effects of fillers on certain resins, thermal conductivity of embedding compounds with various fillers, and many other topics. A discussion is also presented on environmental effects.

92. Havel, J. and A. Culek
Module transistor circuits. SLABOPROUDY OBZOR.
22(5):298–302, 1961. (In Czech.)

A description of various switching circuits and their encapsulation in glass envelopes.

93. Haward, R. N.
THE STRENGTH OF PLASTICS AND GLASS;
A STUDY OF TIME-SENSITIVE MATERIALS.
N. Y., Interscience, 1949. 245p.

94. Hawkins, J. W.
Encapsulation of printed compounds for printed wiring assemblies. In THIRD NATIONAL CONFERENCE ON THE APPLICATION OF ELECTRICAL INSULATION. TECHNICAL PAPERS, CHICAGO, ILL., 5–8 DEC 1960.
N. Y., American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p. 139.

Heiberger, C. A., M. H. Reich and G. Nowlin
Epoxypolyolefins. II. anhydride-polyol-peroxide cure systems. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137th ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1920. Washington, D. C., The American Chemical Society, 1960. v. 20, p. 377.

96. Heiss, H. L.
Durometer cast urethane elastomers. RUBBER AGE 88:89, 1960.

97. Helmreich, R. F. and L. D. Harry
Two flexible epoxy resins. In PROCEEDINGS OF THE DIVISION OF ORGANIC COATINGS AND PLASTICS CHEMISTRY, 138th ACS MEETING, NEW YORK, 11–16 SEP 1960. Washington, D. C., The American Chemical Society, 1960. v. 20, p. 36.

98. Hertz, J.
CRYOGENIC ADHESIVE EVALUATION STUDY. General Dynamics/Astronautics, San Diego, Calif. Rept. no. ERR-AN-032, 25 Jan 1961. 74p. ASTIA AD-273 219.

Five classes of adhesives were evaluated at cryogenic temperatures on the basis of reported high lap-shear strengths at -65 and 75F. Lap-shear specimens were tested at -423, -320, -100, and 75F utilizing epoxy-nylon adhesives (Metlbond 406, AF-40 and FM-1000), nitrile-phenolic adhesives (Metlbond 4041 and AF-32), epoxy-polyamide adhesives (Resiweld No. 4 and Narmco 3135), an epoxy-phenolic adhesive, (Metlbond 302-A), and a polyurethane adhesive (APCO 1219). The adherends utilized were: 0.020 in. EFII 301 CRES, 0.064 in. 2024-T3 bare Al, 0.020 in. A-110-AT Ti, 0.125 Conolon 527 (polyesterfiberglass laminate). Butt-tensile tests were conducted with 3/4 in. round

stock 321 stainless steel and AF-40 epoxy-nylon adhesive. The epoxy-nylon adhesives had the highest lap-shear strengths with all adherents over the entire temperature range. The nitrile-phenolic adhesives gave excellent results from -320 to 78F but dropped off sharply at -423F. The epoxy-phenolic adhesives gave uniform but lower results over the complete temperature range. Room-temperature cured adhesives were generally inferior to those that were heat cured.

99. Hill, J. T. and W. C. Wiedmann
THE EFFECT OF MOISTURE ON THE CURING OF AN EPOXY RESIN SYSTEM. Army Prosthetics Research Lab., Walter Reed Army Medical Center, Washington, D. C. Technical rept. no. 5946, Aug 1959. 1v.

Because of the difficulties encountered in the preparation of porous epoxy laminates in humid weather, an investigation of the effects of moisture on the resin-hardener-solvent system was conducted. The influence of moisture on the stored resin-hardener and diluent was evaluated. The effect of humidity on degree of cure was also determined. The results of these investigations indicated that: (1) the activity of the hardener after storage in contact with moisture was considerably decreased; (2) the activity of the resin, after storage in contact with moisture was slightly decreased; and (3) exposure to high humidity during curing caused a lowering of degree of cure.

100. Howard – Adams, C.
Plastics standards in the U. S. PLASTICS TECHNOLOGY 7:40–45, Dec 1961.

101. Howse, P. T., Jr. and C. D. Pears
Thermal properties of reinforced plastics. MODERN PLASTICS 39:140, Sep 1961.

The specific heats, thermal expansion, and thermal conductivities are given for 12 different resin-reinforcement combinations.

102. Hudson, G. A. and E. R. Wells
Extending polyurethane with tall oil.
RUBBER AGE 91:419–421, Jun 1962.
(6 refs.)

Tall oil can be added to a number of polyurathane formulations as a low cost modifier and extender without impairing the properties of end products. Uses of polyurethanes for sealants and encapsulating materials in electrical equipment is indicated.

103. Hueck, H. J.
The biological deterioration of plastics.
PLASTICS (LONDON) 25:276, 419, Oct 1960.

A discussion is given on the destructive activities of microbiological agents, insects, and rodents.

104. Hueck-van der Plas, E. H.
Biological deterioration of plasticizers in PVC.
PLASTICA 13:1216, Dec 1960. (In Dutch)

The induced deterioration of plasticizers by microorganisms is discussed. Information is given on the susceptibilities of various plasticizers.

105. Hull, J. L.
Equipment and tooling for production with epoxy molding compounds. In TECHNICAL PAPERS, SEVENTEENTH ANNUAL TECHNICAL CONFERENCE, WASHINGTON, D. C., JAN 1961. Washington, D. C., Society of Plastics Engineers, Inc., Baltimore – Washington Section, 1961. v. 7, Sect 16-1.

106. Hull, J. L.
Important considerations in the compression and transfer molding of epoxies. PLASTICS DESIGN AND PROCESSING 1:18–23, Dec 1961.

107. Ihling, R.
A preliminary survey of the properties of commercial plastisols and primers for plastisols. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C. 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p. 201. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

108. IMPACT AND SHOCK RESISTANCE OF PLASTICS: FINAL REPORT. North Carolina State College. (For Bureau of Ships, U. S. Navy.) (OTS PB 151729.) 35p. (n.d.)

109. Jacobson, R. H.
NEW MEDIUM FOR THE PROTECTION OF ELECTRONIC EQUIPMENT AGAINST SHOCK AND VIBRATION. Armour Research Foundation. Rept. no. WADC TR-57-530, Apr 1958. ASTIA AD-151 169.

110. Jahn, H.
STRUCTURE, PROPERTIES AND APPLICATION OF EPOXIDE RESINS (Trans. of: Aufbau, Eigenschaften und Anwendung der Epoxydharze. PLASTE UND KAUTSCHUK. 1:50–56, Mar 1954.)
Air Technical Intelligence Center, Wright-Patterson Air Force Base, Ohio. Trans. no. F-TS-8511/v. 1955. 23p. ASTIA AD-120 652.

After a brief survey over the chemical structure of epoxide resins, their processing methods as well as their mechanical, electric, and other properties are described, with hints as to application possiblities for casting-, compound-, adhesive-, and lacquer-resins.

111. Jaffe, L. D. and J. B. Rittenhouse
BEHAVIOR OF MATERIALS IN SPACE ENVIRONMENTS.
Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Technical rept. no. 32-150, 1 Nov 1961. 116p.
ASTIA AD-266 548.

Quantitative effects of space environments upon engineering materials are discussed. Most metals will be unaffected by vacuum except for slight surface roughening. Among organics, polysulfides, cellulosics, acrylics, polyvinyl chloride, neoprene, and some nylons, polyesters, epoxys, polyurethanes, and alkyds break down at low temperatures in vacuum. Polyethylene, polypropylene, most fluorocarbons, and silicone resins do not decompose significantly in vacuum below 250C. Except for plasticized materials, significant loss of engineering properties in vacuum is unlikely without appreciable accompanying sublimation or decomposition. Certain low vapor pressure oils and greases, tetrafluoroethylene, and thin films of MoS2, Au, and Ag can probably provide adequate lubrication. The particles of the Earth's radiation belts will cause radiation damage to organics and optical properties of inorganic insulators. Semiconductors are affected by solar flare emissions.

112. Jaffe, L. D.
EFFECTS OF SPACE ENVIRONMENT UPON PLASTICS AND ELASTOMERS. Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
Technical rept. no. 32-176, 16 Nov 1961. 22p.
ASTIA AD-268 432.

Most polymers will be stable in the vacuum of space at temperatures as high as they can withstand in air. Important exceptions are some nylons, polysulfides, cellulosics, acrylics, polyesters, epoxies, and urethanes. Exposure to vacuum will not cause loss of engineering properties unless appreciable loss in weight occurs. Through a shielding thickness of 1 g/cc, only the more radiation-sensitive polymers will be damaged by the Van Allen belts, and solar flare emissions will cause no permanent damage. Sunlight of 100-1000 angstroms wavelength may significantly increase optical absorption by the outer few thousand angstroms of an exposed surface. Longer solar wavelengths induce crosslinking to much greater depths, reducing elastomer flexibility and increasing optical absorption. Most other engineering properties are likely to be less affected by sunlight in space than on the Earth's surface. Meteoric erosion will produce on exposed surfaces a few pits, mostly smaller than .01 cm diameter; this pitting will be much more common close to Earth than away from it. When structural laminates are hit by larger meteoroids, spalling of pieces off the inside surface of the plastic will occur through considerably greater thicknesses than will perforation.

113. Jansson, R. M.
MAXIMUM DENSITY PACKAGING OF ANALOG ELECTRONICS. Instrumentation Lab., Mass. Inst. of Tech., Cambridge, Mass. Rept. no. MIT IL E-765, Oct 1958.

The M.I.T. Instrumentation Laboratory has developed and is continuing to develop electronic packaging techniques which can be supplied to subminiature electronic devices and complex systems. These techniques are based on the mounting and wiring of circuit components in a three-dimensional unit mass. Using the most suitable electronic circuit components now available, the Instrumentation Laboratory has achieved maximum component densities. These densities are obtained without sacrificing production feasibility. The Laboratory's packaging techniques are immediately available for use and have design flexibilities great enough to handle a variety of circuitry.

114. Jennings, R.
Foams in electronics. SOC. PLASTICS ENG. J.
16:319, Mar 1960.

A brief review of the application of foams in potting, missiles, and microwave apparatus.

115. John, H. F.
PROTECTIVE TREATMENT FOR SEMI-CONDUCTOR DEVICES. (Assigned to Westinghouse Electric Corp.) U. S. Patent 2,937,110. 17 May 1960.

A process is described for surface treating Ge and Si diodes and transistors prior to their encapsulation in a resin or hermitically sealed container. The process requires the use of finely divided particles of lead tetraoxide or mercuric oxide which is mixed in an elastomeric silicon resin in the weight ratio of 0.6 to 2.0 parts metal oxide to 1.0 part resin. The curing process is also described.

116. Johnson, G. O., Jr.
MODULAR DESIGN OF IMPROVED SOLAR CONVERTERS. Hamilton Standard Div., United Aircr ft Corp. Broad Brook, Conn.
Quarterly progress rept. no. 1, 1 Jun–31 Aug 1961.
Rept. no. HSER 2335, 31 Aug 1961. 35p. ASTIA AD-269 232.

Studies were made of materials and design concepts for use in the modular solar converter. A survey was made to determine whether available adhesives and coating or covering materials were suitable for this application. Several of the materials showed promise and are to be tested. The results of a preliminary mechanical design study are reported. Several concepts are presented and discussed which are based on an 80 cell, 1 w, 7.75 v module arranged in a typical 50 w solar array. Thermal calculations are presented to show the heat dissipating capability of the array and to indicate cell temperature in a 125F ambient. Calculations of wind forces, the most severe mechanical stress on an erected array, are presented.

117. Jones, D. P.
Epoxies for the Tiros satellite. ADHESIVES AGE p. 28–29, May 1961.

Components, power supply and circuitry in Tiros meteorological satellites are protected against the hazards of space flight by epoxy resin formulations serving as adhesives, coatings, sealants and encapsulations.

118. Kaelble, D. H.
The dynamic mechanical properties of epoxy resins. SOC. PLASTICS ENG. J. 15:1071, Dec 1959.

A correlation is given between the softening temperatures and the regions of major dynamic mechanical dispersion.

119. Kalfayan, S.
The use of polyurethanes in electrical sealing. In SEALANTS AND SEALING OF AIRCRAFT, MISSILES, AND ELECTRICAL COMPONENTS, LOS ANGELES, CALIFORNIA, 28–29 OCT 1959. Los Angeles, Society of Aircraft Materials and Process Engineers, 1959.

120. Kies, J. A.
MAXIMUM STRAINS IN THE RESIN OF FIBER-GLASS COMPOSITES. Naval Research Lab., Washington, D. C. NRL rept. no. 5752, 26 Mar 1962. 12p. ASTIA AD-274 560.

A simple analysis was made of models representing possible conditions in glass-fiber-reinforced plastics. The analysis shows that for strains imposed in a direction transverse to a set of windings, the ratio of tensile strain in the resin to the average measured strain can approach E sub g/E sub r as the resin content is decreased to the limit for filling the interstices, where E sub g and E sub r are Young's modulus for glass and resin, repsectively. For shear strains the maximum strain concentration in the resin can be as high as 0.7 G sub g/G sub r, where G sub g and G sub r are

the shear moduli of glass and resin. Measured average strains in service are as high as two percent. The strain in the resin in a direction transvers to the fibers is correspondingly about 40 percent. No resin in ordinary structural use can stand this strain without cracking.

121. Kitchen, L. J., G. L. Hall and J. D. Rigby
Effect on elastomers of exposure at temperatures up to 1000°F. In ELASTOMER RESEARCH AND DEVELOPMENT, PROCEEDINGS OF THE SIXTH JOINT ARMY-NAVY-AIR FORCE CONFERENCE, BOSTON, MASS., 18–20 OCT 1960. J. C. Montermoso and F. R. Fisher, eds. (Sponsored by: U.S. Army quartermaster Research and Engineering Command). ASTIA AD-250 916. p. 265–288.

122. Klute, C. H. and B. W. Shellenbarger
THE HEAT OF POLYMERIZATION OF PHENYL GLYCIDYL ETHER AND OF AN EPOXY RESIN. PART II. EFFECT OF ALCOHOL ON THE POLYMERIZATION. DOFL rept. no. TR-791, 9 Nov 1959. 9p. ASTIA AD-229 092.

In a previous report (AD-226 590) the heats of polymerization of phenyl glycidyl ether were compared with those of an epoxy resin for a variety of polymerication catalysts. In those experiments 20 parts by weight of ethylene glycol per 100 parts of phenyl glycidyl ether were added to the ether to serve as a cocatalyst. In the present report it is demonstrated that, when lesser amounts of alcohol are used, the measured heats of polymerization are not significantly different from the values obtained earlier.

123. Klute, C. H. and W. Viehmann
HEAT OF POLYMERIZATION OF PHENYL GLYCIDYL ETHER AND OF AN EPOXY RESIN.
Diamond Ordnance Fuze Lab., Washington, D. C.
Rept. no. TR-758, 28 Aug 1959. ASTIA AD-226 590.

A differential thermal analysis apparatus was designed and constructed for the accurate measurement of hearts of polymerization. With this apparatus the mean value for three determinations of the heats of polymerization of epoxy resins or of phenyl glycidyl ether could be measured to within a standard error of 0.37 kcal per mole. Primary amine curing agents released about 26 kcal per mole, tertiary amines and boron trifluoride-ether complex each released about 22 kcal per mole and mixed type curing agents which could react in part as tertiary amines and in part as primary amines released intermediate amounts of heat.

124. Knight, R. D.
Equipment for the encapsulation of semiconductor devices. J. SCI. INSTR. 37:197–199, Jun 1960.

A description is given of the encapsulation assembly and the manner in which it works. Particular emphasis is placed on the creation of gas-tight seals.

125. Kolenko, E. A. and V. G. Iur'ev
An investigation of some vacuum properties of epoxy resins. SOVIET PHYS. TECH. PHYS. 31(Pt4):2073, 1958.

Many technological uses are found for epoxy resins with different polymerization temperatures. The far reaching importance of these materials in the different branches of engineering is beyond doubt. As a result of investigations it is clear that resins, after polymerization, are vacuum-dense materials.

126. Lee, H. and K. Neville
EPOXY RESINS. N. Y., McGraw-Hill, 1957. 305p.

127. Lee, M M. and R. D. Hodges
Heat resistant encapsulating resins.
PLASTICS TECHNOLOGY 6:43–53, Apr 1960.

Many important properties of encapsulating resins deteriorate rapidly under high temperature conditions. The degree of deterioration depends largely on the type of hardener used. A description is given of the physical response of various resins to thermal tests.

128. Lew, W. B. and W. Sergent
Transient properties of three castable polyurethane compounds. In ELASTOMER RESEARCH AND DEVELOPMENT, PROCEEDINGS OF THE SIXTH JOINT ARMY-NAVY-AIR FORCE CONFERENCE, BOSTON, MASS., 18–20 OCT 1960.
J. C. Montermose and F. R. Fisher, eds.
(Sponsored by: U.S. Army Quartermaster Research and Engineering Command)
ASTIA AD-250 916. p. 501–517.

129. Linden, E. G.
CASTING RESINS. Squier Signal Lab., Signal Corps Engineering Lab., Fort Monmouth, N. J. Information bull. no. 84 and Suppl., 9 Nov 1951, 17p. ASTIA AD-165.

A resume is presented concerning (1) the required properties of casting resins for embedding or encapsulating electrical components and (2) the status of resin development by various manufacturers.

130. Linden, E. G.
ENCAPSULATING RESINS AND POTTING COMPOUNDS. Signal Corps Engineering Labs., Fort Monmouth, N. J. Engineering rept. no. E-1101, 1 Oct 1955. 67p.

Laboratory and literature data are presented on casting resins and potting compounds; and the materials are discussed in terms of their applications, specifications, and properties. Information on the encapsulating materials includes cure, molds, mold-releases, thermal properties, electrical characteristics, moisture barrier ratings, weathering, adhesiveness, flame-retardancy, corrosiveness, fungal growth, shrinkage, density, nuclear radiation, shock, and impact. The types of material discussed include hot melts, foams, castable ceramics, polyesters, epoxides, polyurethanes, furanes, phenolics, polyvinyl formal resins, plastisols, and styrene based polymers.

131. Linden, E.
Thermal properties of encapsulating materials. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.255. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

132. Linden, E.
The effects of outdoor weather aging on encapsulating materials. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1945. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.326. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

133. Lines, E. W.
Four epoxy plasticizers. PLASTICS TECHNOLOGY 7(3):51–55, Mar 1961.

Data on the performance and compatibility of four epoxy resins is given. Three of the resins are secondary and the other is primary. One of the epoxidized soybean oils can be used as an inexpensive extender for epoxy resins, permitting increased loadings of pigments or fillers.

134. Lyman, D. J.
The solution polymerization of diisocyanates with ethylene glycol. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137TH ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. Washington, D. C., The American Chemical Society, 1960. v.20, p.116.

135. Mallard, P., C. Nadler and J. Bowen
Elastomeric potting compounds for aircraft electrical connections. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.60. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

136. Malootian, M.
Polyurethane potting resins. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.156. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

137. Mark, H., E. S. Proskauer, and V. J. Frilette
RESINS – RUBBERS – PLASTICS YEARBOOK
1959. N. Y., Interscience, 1959. 1568p.

A compilation of abstracts on the polymerization and mechanism of organic reactions in rubber and plastic resins. Many of the abstracts contain original data, charts, graphs, photographs, and other pertinent information.

138. Martens, C. R.
ALKYD RESINS. N. Y., Reinhold, 1961. 155p.

A thorough survey of the properties, chemistry, production, and applications of alkyd resins. An explanation is given of the different types and modifications of these resins as well as a description of the methods of modifying their properties. Coating and non-coating applications are discussed.

139. Martinovich, R. J., P. J. Boeke and R. A. McCord
Melt index equivalent – a new flow parameter.
SOC. PLASTICS ENG. J. 16:1335, Dec 1960.

A method of predicting the effect of differing molecular weight distributions on polymer properties is described.

140. Mattice, J. J.
THE VACUUM-THERMAL STABILITY OF ORGANIC COATING MATERIALS, PART I. THE POLY-URETHANES. Wright Air Development Division, Wright-Patterson AFB, Ohio. Rept. no. WADD TR 60-126, Part I, Aug 1960. 36p.

This report is divided into two sections. Section 1 is a survey of the basic knowledge of polyurethane chemistry and of the research which has been conducted in studying the synthesis and degradation reactions of these materials. The application of this information in studying the adverse effects of the high vacuum of space and high temperature is emphasized. Section 2 presents the results of the vacuum-thermal exposures of commercially available, unmodified resins. The relationship between structure, cure, film thickness and weight losses of the polymers is discussed. The urethane bond appears to be the major labile species, leading to a characteristic degradation, regardless of structure which is complete at 500°F. The physical appearance and properties of degrading films is good and pigmentation of a film with titanium dioxide has different effects at differing temperature levels.

141. May, C. A. and A. C. Nixon
A study of reactive diluents in aromatic amine-cured epoxy adhesives. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137TH ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. Washington, D. C., The American Chemical Society. 1960. v. 20, p.1.

142. Mills, K.
Environmental protection of guidance modules, printed circuits and connectors. In APPLICATION OF ELECTRICAL INSULATION, THIRD ANNUAL NATIONAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, Ill., American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p.162.

143. Molzon, A. E. and S. A. Slota
EVALUATION OF PLASTIC ENCAPSULATING MATERIALS. Feltman Research Labs., Picatinny Arsenal, Dover, N. J. Technical rept. no. FRL-TR-4, Aug 1960. 46p. ASTIA AD-243 025L.

(Notice: Only Military Offices may request from ASTIA. Others request approval of Diamond Ordnance Fuze Labs., Washington 25, D. C. Attn: ORDTL 06.33.)

Commercially available plastic encapsulating materials were selected and test specimens fabricated and tested to obtain design data on volume resistivity, exotherm, thermal expansion, and casting shrinkage. The materials selected for this study were those which gave promise of meeting the following conditions: (1) The exotherm should be below 170°F for a sample of 2 inches diam. × 7/8 inch thick which could be cured at

or below 160°F. (2) The volume resistivity should be at least 10^{14} ohm-cm over the temperature range -65°F to 160°F. Ten systems were tested, including filled and unfilled epoxies, polyurethane foam and casting resin, and polystyrene foam. The coefficient of thermal expansion over the temperature range -65°F to 160°F varied from 1.6×10^{-5} inch/inch/°F for a filled epoxy to 4.8×10^{-5} for an unfilled epoxy to 7.0×10^{-5} for an unfilled polyurethane casting material. Casting shrinkage varied from 0.003 inch/inch for a filled epoxy to 0.015 inch/inch for the polyurethane casting material. Data was obtained on hardness vs time, and volume resistivity vs time at 160°F for up to 200 hours.

144. M.lzon, A. E.
RECENT DEVELOPMENTS IN CASTING RESINS AND TECHNOLOGY FOR ELECTRICAL ENCAPSULATION APPLICATION. Plastic Technical Evaluation Center, Picatinny Arsenal, Dover, N. J. PLASTEC rept. 3, Nov 1960. (OTS PB-171 034).

145. Molzon, A. E.
INDEXED REFERENCES PERTAINING TO DEGRADATION AND FRACTURE OF PLASTICS. Plastic Technical Evaluation Center, Picatinny Arsenal, Dover, N. J. PLASTEC note 2, Aug 1961.

146. Moylan, J. J. and J. T. Long
How to encapsulate with alkyds. MODERN PLASTICS 37:124–128, Mar 1960.

A description of molding practices used to encapsulate electrical components.

147. Namaroff, J. H.
STANDARD MODULES FOR AVIONICS EQUIPMENT. Melpar, Inc., Falls Church, Va. Final rept. Rept. no. NADC-EL-6181, 21 Sep 1961. 214p. ASTIA AD-266 609.

A consolidated report has been prepared to provide supporting data for the development and standardization of modules and cooling test fixtures, fabrication of modules, and the design and development of transistor modules in the form of expendable and repairable packages.

148. Nelzel, R. G. and J. R. Dillinger
Epoxy resin as a material for constructing cryogenic apparatus. REV. SCI. INSTR. 32:855, Jul 1961.

149. Neumann, J. A. and F. J. Bockhoff
WELDING OF PLASTICS. N. Y., Reinhold, 1959. 279p.

The book describes various welding techniques in detail. Helpful tables are included on trade names, chemical resistance, service ratings, and service temperatures of weldable plastic materials.

150. Newkirk, R. F.
Polyurethane foams for environmental protection. <u>In</u> APPLICATION OF ELECTRICAL INSULATION, THIRD ANNUAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p.163.

151. Nichols, P.
The control of chemical and physical factors in the application of casting resins. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.216. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

152. Noble, R. P.
A MODERN CONCEPT OF ELECTRONIC PACKAGING. Sandia Corp., Albuquerque, N. Mex. Rept. no. SCTM-275-56 (14), 8 Jan 1957. 33p.

The relationship between human engineering, design approach, and engineering management is presented. Application of electronic packaging with printed circuit design is discussed, and several slides illustrating finished units are shown. A modern design approach is explained, both from management's standpoint and the design engineer's point of view. Design procedure is discussed and the various functions and responsibilities of a design group are outlined.

153. Odian, G., T. Acker and G. Kramer
DEVELOPMENT OF TRANSPARENT PLASTIC MOISTURE BARRIERS BY RADIATION – INDUCED GRAFT POLYMERIZATION. Radiation Applications, Inc., Long Island, N. Y. Progress rept., 1 Oct–30 Nov 1961. ASTIA AD-271 407L.

154. Offenbach, J. A. and A. V. Tobolsky
CHEMICAL RELAXATION OF STRESS IN
POLYURETHANE ELASTOMERS.
Frick Chemical Lab., Princeton U., N. J.
Technical rept. no. RLT-17, 15 Nov 1955.
18p. ASTIA AD-79 168.

Chemical stress relaxation behavior of 3 polyester urethane elastomers (Vulcollans) and a polyether elastomer (DuPont Adiprene B) were determined over a temperature range of 90° to 130°C. Extension was not included as a variable, because it has little effect in other polymeric systems exhibiting stress decay due to chemical bond cleavage. The data are presented in terms of the percentage of residual stress as a function of logarithmic time. The plotted curves of all 4 samples approach zero stress asymptotically, and the greater portion of the decay occurs within 2 cycles of logarithmic time. The activation energies of the samples all are of the same order of magnitude. An initial weight increase of 16 percent resulted when Vulcollan B was immersed in polyethylene glycol 300 at 80°C for 1 hr; the rubber became soft and exhibited low tear strength. The known thermal lability of the urea and urethane groups is considered as indicative of possible sites of network scission.

155. Perry, H. A.
ADHESIVE BONDING OF REINFORCED PLASTICS.
N. Y., McGraw-Hill, 1959. 275p.

156. Peterson, G. P.
Properties of high modulus reinforced plastics.
SOC. PLASTICS ENG. J. 17:57, Jan 1961.

Data is presented to show that glass filament containing berylium oxide increases modulus.

157. Pigott, K A., B. F. Frye, et al.
Development of cast urethane elastomers for
ultimate properties. J. CHEM. ENG. DATA
5:391–395, 1960.

158. Pigott, K. A. et al.
A wider hardness range for cast polyester urethane elastomers. RUBBER AGE 91:629−631, Jul 1962.

A greater modulus and hardness along with moderate increases in tear strength can be obtained by increasing the concentrations of aromatic and urethane groups in the polymers.

159. Phillips, B., et al.
POLYMERIZABLE EPOXIDES. (Assigned to Union Carbide Corp.) British Patent 866,410. 26 Apr 1961.

The compositions are made from divinyl dioxide and polycarboxylic acid compounds. The advantages of using these compounds in the potting of electronic components are discussed.

160. Phillips, I. and D. V. Bartlett
Permeability of plastics. BRIT. PLASTICS 34:533, Oct 1961.

A description is given of the work which has been performed on measuring permeabilit
constants.

161. Pollack, A.
Electronic packages vs space torture. ENVIRONMENTAL QUARTERLY 7(4):20−23, Oct 1961.

A delineation is made of the factors which must be taken into consideration in designin reliable electronic equipment for space environment. Methods of testing materials an coatings to be used in such equipment are discussed.

162. POLYURETHANE RUBBER BIBLIOGRAPHY.
Rock Island Arsenal Lab., Ill. RIA Lab. no.
55-2988, 2 Aug 1955. 27p. ASTIA AD-143 082.

References in this bibliography are divided into 2 main sections. The first section contains 141 references from the open literature on polyurethane rubber covering the period of February 1953 to June 1955. The references are arranged alphabetically according to author. The references in the second section are to patents; they are grouped alphabetically by country of origin and are arranged by ascending patent number. The patents are from Belgium, England, France, Germany, Italy, Japan, and the U.S.

163. Prise, W. and H. M. Wagner
A realistic approach to encapsulation of welded packages. In WELDED ELECTRONICS PACKAGING, FIFTH SYMPOSIUM, SUNNYVALE, CALIFORNIA, 21 AUG 1961. Sunnyvale, Calif., Lockheed Missiles and Space Company. Stanford, Calif., Stanford University Press, 1961.

This paper discusses the problems related to encapsulation of welded electronics circuitry in plastic materials. It emphasizes the lack of information from the vendor. It outlines a project currently in progress at Lockheed with the purpose of collecting, screening, and verifying the required information. The results of this project eventually will lead to a Design Handbook on Encapsulation Materials for electronics purposes.

164. Pschoor, F. E. and A. N. Cianciarulo
Weathering of epoxy resin systems.
In TECHNICAL PAPERS, SEVENTEENTH ANNUAL TECHNICAL CONFERENCE, WASHINGTON, D. C., JAN 1961. Washington, Society of Plastics Engineers, Inc., Baltimore-Washington Section, 1961. v.7, Sect. 24-2.

165. QUALIFICATION OF EPOCAST 15E EMBEDDING COMPOUND SUBMITTED BY FURANCE PLASTICS, INCORPORATED.
Material Lab., New York Naval Shipyard, Brooklyn. Final rept. 11 Jun 1959. 13p.
ASTIA AD-208 032L.

The sample Epocast 15E embedding compound complied with the Type D requirements of MIL-1-16923C with the following exceptions: (a) Dissipation factor at 10 megacycles which was 20% higher than the specified value. (b) One thousand cycle dissipation factor at 130°C and 155°C which were 13% and 100% higher than the specified values respectively. (c) Flammability. (d) Heat resistance – The percent weight loss was 119% higher than the specified value. (e) Coefficient of linear thermal expansion which was 34% higher than the specified value. (f) Thermal shock resistance could not be determined because of specimen preparation difficulties. It appears that the inability to cast satisfactory thermal shock specimens and specimens to determine the effect of high humidity at 70°C was due, in most part, to the high linear thermal expansion exhibited by this material.

166. Quant, A. J.
A LOW-DENSITY POTTING COMPOUND.
Sandia Corp., Albuquerque, N. Mex.
Rept. no. SCR-417A, Jun 1961. First revision Aug 1961. 31p. (Preprinted for Second International Electronic Circuit Packaging Symposium, Bureau of Continuation Education, Univ. of Colorado, Boulder, Aug 1961.)

A combined total of 4 years development effort and production experience proved conclusively the value of a glass-microballoon-filled epoxy resin system in pottin applications where weight saving, without a drastic sacrifice in physical properties, or resistance to high-level mechanical shock is a prime requirement.

167. Rahm, L. F.
FINAL REPT. 1 MARCH 1954–30 NOVEMBER 1955. STATUS REPT. NO. 39, 1 SEPTEMBER 1955–30 NOVEMBER 1955. Plastics Lab., Princeton U., N. J. Contract rept. no. 7, 1 Dec 1955. 16p. ASTIA AD-87 210.

Plastics research is summarized with respect to the comparative physical and dielectric properties of homologous polyurethanes and polyamides, the chain-transfer mechanism of bicyclic hydrocarbons, and specific ferrocene derivatives and polymers prepared from them (both the vinyl and condensation types). The bicyclic compounds were of the 2, 2, 1-heptyl system in which various Me-substituted and olefinic variants were examined with respect to chain transfer in the thermal polymerization of styrene at several temperatures. Chain-transfer constants for several hydrocarbons showed no substantial increases with radical displacement. Measurements of the dipolar contribution to the dielectric constant were made on a fourth series of poly-(p-chlorostyrene-styrene) copolymer-polystyrene mixtures. The presence of the polystyrene molecules did not increase the average inter-chain separations of polar segments of the copolymer. Efforts were directed toward determining the mechanical engineering properties of plastics at use conditions and the rheological properties of plastics at their fabricating conditions. The resistance to indentation by plastic materials is dependent on the rate of indenting, the energy available to the indenter, and the temperature of the material. The relative hardness ratings of various materials may be interchanged by small changes in the variables.

168. Rausch, D. A. and A. M. Lovelace
THE PREPARATION AND PROPERTIES OF SOME NEW FLUORINE-CONTAINING 1, 2-EPOXIDES. Materials Lab., Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. Rept. for Apr–Sep 1955 on Rubber, Plastic and Composite Materials and Synthesis and Evaluation of New Polymers. WADC Technical rept. no. 56-94, May 1956. 6p. ASTIA AD-106 741.

Interest in F-containing polyethers for possible application as thermally stable elastomers prompted research on the preparation of new epoxide monomers. The

following reactions were employed in preparing 6 F-containing epoxides:

(I) $C_3F_7COOH + C_3H_7MgBr \rightarrow C_3F_7COC_3H_7$;

(II) $C_3F_7COOLi + C_3H_7MgBr \rightarrow C_3F_7COC_3H_7$;

(III) $C_3F_7COC_3H_7 + BR_2/H_2SO_4 \rightarrow C_3F_7COCHBrC_2H_5$;

(IV) $C_3F_7COCHBrC_2H_5 + LiAlH_4 \rightarrow C_3F_7CHOHCHBrC_2H_5$;

(V) $C_3F_7CHOHCHBrC_2H_5 + NaOH/H_2O \rightarrow C_3F_7\overset{O}{\overbrace{CH-CH}}C_2H_5$; and

(VI) $C_3F_7\overset{O}{\overbrace{CH-CH}}C_2H_5 + H_2SO_4/H_2O \rightarrow C_3F_7CHOHCHOHC_2H_5$. Reactions I and II represent the procedures used in preparing the starting ketones. The bromination reaction, III, was carried out in concentrated H_2SO_4. The reduction of the bromo-ketones reaction, IV, was effected with an ether slurry of LiAlH . The bromo-alcohols were then added dropwise to hot 50% aqueous NaOH solution in reaction V. Treatment of the epoxides with 6M H_2SO_4 gave the corresponding vicinal diols in reaction VI: The following epoxides were prepared:

$CF_3\overset{O}{\overbrace{CH-CH}}CH_3$, $CF_3\overset{O}{\overbrace{CH-CH}}C_2H_5$, $CF_3\overset{O}{\overbrace{CH-C}}(CH_3)_2$. $C_3F_7\overset{O}{\overbrace{CH-CH}}CH_3$, $C_3F_7\overset{O}{\overbrace{C-CH}}C_2H_5$, and $C_3F_7\overset{O}{\overbrace{CH-C}}(CH_3)_2$.

169. Richard, M. and M. Krotzsch
Epoxide resins as packing material for insulated electrodes in high pressure plant. PLASTE U. KAUTSCHUK 6:63, Feb 1959. (In German)

A description is given of a high-pressure plunger, containing seven insulated electrodes, and having a diameter of 26 mm. A mixture of epoxide casting resin and quartz sand was used for insulation and packing the electrodes.

170. Riley, M.
The effect of thermal shock on the shape and adhesion of various commercial compounds. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.271. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

171. Ringwood, A. F.
Epoxy resins for the encapsulation of electronic components. SOC. PLASTICS ENG. J. 16:93, Jan 1960.

Properly formulated epoxy compounds are shown to be satisfactory for electronic encapsulations.

172. Roeser, G. P.
SOLVENT FOR VINYL CHLORIDE-VINYL ACETATE COPOLYMERS. (Assigned to American-Marietta Co.) U. S. Patent 2,913,430. 17 Nov 1959.

173. Royall, W. B. and R. W. Matlock
Epoxy passes toughest test: outer space. MODERN PLASTICS 39:100–101, 205, 210, Oct 1961.

174. Ruetman, S. H. and H. H. Levine
RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES.
Narmco Industries, Inc., San Diego, Calif.
Quarterly progress rept. no. 5, 1 Sep 1961–31 Jan 1962. Feb 1962. 58p. ASTIA AD-272 961.

Constructive pyrolysis of silicone-phenolic laminates at elevated temperatures in Ar indicated a major structural change in the resin at 1250°F. A very large decrease in volume resistivity occurred. Approximately the same oustanding oxidation resistance and good retention of high temperature tensile shear strength were obtained at 1500 and 1800°F. When exposed to air for 30 hours at 650°F a refrasil laminate, made with zirconium phenoxy-aldehyde resin, underwent complete oxidative destruction, despite the previous constructive pyrolysis in Ar at 1800°F. A laminate made with phosphonitrilic chloride-hydroquinone condensation products delaminated at 500°F in Ar. The 1800°F pyrolyzed specimens had good oxidation resistance at 650°F, in air. An epoxy-novolac adhesive cured with As2S3 + As205 had a tensile shear strength of 940 psi after 10 min at 1000°F. Another formulation containing As203 in place of As205 gave 975 psi after 1000 hours at 500°F and 855 psi after 10 minutes at 1000°F. 1.4-Butanediphosphonic acid, arsenic thioarsenate, bis-(-2-hydroxyphenyl) methane, 1.2-propylene sulfide, 1-chloro-2, 3-propylene sulfide, beta-hydroxythiouronium were synthesized.

175. Ruff, A. E. and A. D. Delman
EVALUATION OF THE SUITABILITY OF "RHO" SOLVENT FOR REMOVAL OF BEDDING COMPOUNDS FROM ELECTRICAL AND ELECTRONIC EQUIPMENT SUBMITTED BY THE RHO COMPANY, LOS ANGELES, CALIF. Material Lab., New York Naval Shipyard, Brooklyn. Final rept. 16 Apr 1956. 20p. ASTIA AD-94 273. (Copies obtainable from ASTIA by U.S. Military Organizations only)

176. Rugg, G. B.
Molding vs casting for epoxy encapsulation.
MODERN PLASTICS 39:109, Sep 1961.

A comparison is made of methods used for certain electrical applications.

177. Rust, J. B. and C. L. Segal
DEVELOPMENT OF ULTRA HIGH TEMPERATURE DIELECTRIC MATERIALS FOR EMBEDDING ELECTRONIC PARTS. Hughes Aircraft Co., Culver City, Calif. Quarterly progress rept. no. 1, 10 Feb—10 May 1959, on a program to develop and evaluate silicone or modified silicone dielectric materials. 30 May 1959. 28p. ASTIA AD-228 239L.

This report describes the work on a program to develop and evaluate silicone or modified silicone dielectric materials which will be useful for embedding electronic parts which must function continuously at 350°C ambient temperature. Two monomeric arylenesilane compounds were prepared: 1,4 bis(dimethylethoxysilyl) benzene and 1,4 bis(methylvinylethoxysilyl) benzene. These monomers were subsequently cohydrolized with either methylvinyldiethoxysilane or dimethyldiethoxysilane. The cohydrolysis products were viscous fluids containing a multifunctionality of vinyl groups appended to a polyarylenesiloxane chain. The monomers and 'prepolymers' were identified by infrared absorption spectroscopy. Dibutyltin dihydride was prepared for use as a potential crosslinking agent. A commercially available polysiloxane polymer was identified as being similar to the cohydrolysis products prepared during this program. The commercial resin, DC 7521, was combined with either dibutyltin dihydride or silicon oxyhydride, in the presence and absence of several catalysts, in an attempt to crosslink the polymers. Crosslinking did not appear to proceed under the conditions used in these experiments.

178. Rust, J. B. and C. L. Segal
DEVELOPMENT OF ULTRA HIGH TEMPERATURE DIELECTRIC MATERIALS FOR EMBEDDING ELECTRONIC PARTS. Hughes Aircraft Co., Culver City, Calif. Quarterly progress rept. no. 2, 10 May—10 Aug 1959, on a program to develop and evaluate silicone of modified silicone dielectric materials. 30 Aug 1959. 36p. ASTIA AD-228 658L.

A polyvinlarylenesilane-polyvinylsiloxane copolymer, a polyvinylarylenesilane polymer, and a polyvinylarylenesiloxane-polyvinylsiloxane copolymer were synthesized. These prepolymers exhibited low viscosity (100 to 6000 centipoise) and a high vinyl content

(15 to 20 wt-%). Organotin hydrides and organosilicon hydrides were prepared as crosslinking agents. Crosslinking of the polyvinyl prepolymers was attempted by peroxides, by organometallic hydrides, and by a combination of these two. Organotin hydrides did not require peroxides or activators to promote the crosslinking of the prepolymers. The organometallic hydrides which appeared most favorable for crosslinking polyolefin silicon-containing resins were diphenyltin dihydride, bis(silyl)benzene, diphenylsilane, trimethylamine borane, and pyridine borane. Thermal evaluation tests showed that the organometallic hydride-polyvinylsiloxane systems have improved thermal stability over similar systems catalyzed with peroxide.

179. Rust, J. B., C. L. Segal and M. Bart
DEVELOPMENT OF ULTRA HIGH TEMPERATURE DIELECTRIC MATERIALS FOR EMBEDDING ELECTRONIC PARTS. Hughes Aircraft Co., Culver City, Calif. Quarterly progress rept. no. 3, 10 Aug–10 Nov 1959, on a program to develop and evaluate silicone or modified silicone dielectric materials. 31 Nov 1959. 43p.
ASTIA AD-240 781.

Five new poly(vinyl)arylenesilane prepolymers were prepared by the condensation of the di-Grignard of p-dibromobenzene and a mixture of dichlorosilanes. The resulting prepolymers ranged from viscous fluids to rigid solids. Large quantities (200 grams) of a new crosslinking agent, bis(silyl)benzene, were synthesized and fully characterized by a series of chemical and physical tests. Crosslinking of a poly(vinyl) 'siloxane prepolymer by various combinations of organic peroxides and bis(silyl)benzene was investigated. Kinetics of the reaction between bis(silyl)benzene and a poly(vinyl) siloxane prepolymer were studied in detail, and rate constants were determined from observed changes in viscosity with time. Electrical and thermal shock test data indicated that the use of bis(silyl)benzene as a crosslinking agent did not effect the electrical or mechanical properties of the embedding composition; however, thermal test data showed a distinct improvement over that of the conventional peroxide cure could be obtained by using the new crosslinking agent. Weight loss of an unfilled specimen of a poly(vinyl) siloxane prepolymer (DC-7521) cured with bis(silyl)benzene was two percent after 12 hours at 300°C; a similar system cured with di-t-butyl peroxide lost four percent during the same exposure; an uncatalyzed experimental prepolymer lost one percent after 30 minutes at 350°C; a comparable proprietary prepolymer (DC-7521) lost eight percent during the same exposure. Preliminary results of a test series in which an experimental prepolymer was crosslinked with bis(silyl)benzene demonstrated that a 600 percent improvement in weight loss at 350°C could be gained over a comparable proprietary prepolymer (DC-7521) cured with an organic peroxide.

180. Saunders, J. H.
The relations between polymer structure and properties in urethanes. RUBBER CHEM. TECH. 33:1259–1293, 1960.

181. Schollenberger, C. S., et al.
Environmental resistance of estane urethane materials. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137TH ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. Washington, D. C., The American Chemical Society, 1960. v.20, p.212.

182. Schollenberger, C. S. and K. Dinbergs
A study of the weathering of an elastomeric polyurethane. SOC. PLASTICS ENG. TECH. 1:31–39, 1961.

A study was designed to show the nature of weathering of an elastomer polyester-urethane, and to indicate methods of overcoming the deficiency. An unprotected polymer, when exposed to UV radiation in a Weatherometer, showing deterioration which is characterized by loss of tensile strength, some increase in modulus and a decreased extensibility of surface skin.

183. Segal, C. L., et al.
A novel silicone embedding compound. In PROCEEDINGS OF THE DIVISION OF ORGANIC COATINGS AND PLASTICS CHEMISTRY, 138TH ACS MEETING, NEW YORK, 11–16 SEP 1960. Washington, D. C., The American Chemical Society, 1960. v.20, p.187.

184. Sensi, J. and P. J. Franklin
Machines and techniques for applying multi-constituent casting resins. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24–25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 26 Jan 1956. p. 85. (Also in: ELECTRONICS EQUIPMENT, Jul 1956.)

185. Siff, W. C.
Controlling quality in a plastics processing plant. In TECHNICAL PAPERS, SEVENTEENTH ANNUAL TECHNICAL CONFERENCE, WASHINGTON, D. C., JAN 1961. Washington, D. C., Society of Plastics Engineers, Inc., Baltimore-Washington Section, 1961. v. 7, Sect. 13-3.

186. Simonds, H. R.
SOURCE BOOK OF THE NEW PLASTICS. N. Y., Heinhold, 1959. vol. 2, 310p.

Significant information is presented on the newer important plastics. Data is included on properties, production, price, application, and selection.

187. Smoluk, G. R.
THE EFFECT OF MOLECULAR STRUCTURE ON THE PROPERTIES OF THE POLYURETHANES. Plastics Laboratory, Princeton University. Technical rept. no. 21C, 18 Jul 1951.

188. Society of Plastics Engineers. Plastics in Packaging. In TECHNICAL PAPERS, REGIONAL TECHNICAL CONFERENCE, BERKELEY, CALIF., 19 NOV 1959. (Sponsored by Golden Gate Section, SPE.) 1959. 80p.

189. SPI procedure for running exotherm curves-polyester resins. In PROCEEDINGS OF THE SIXTEENTH ANNUAL TECHNICAL AND MANAGEMENT CONFERENCE, CHICAGO, ILL., FEB 1961. (Sponsored by: Reinforced Plastics Division.) N. Y., Society of the Plastics Industry, Inc. 1961. Materials I sect.

190. Swann, M. H. A NEW "SPOT" TEST FOR EPOXY RESINS. Coating and Chemical Lab., Aberdeen Proving Ground, Md. Rept. no. CCL 57, 2 Jun 1958. 4p. ASTIA AD-161 856.

A new, rapid "spot" test for bisphenol-type epoxy resins is described that will be very useful in routine identification of synthetic resins in coating materials. Although this test is not the first available for the purpose, it is specific and exceptionally rapid and simple to conduct. It is applicable to all types of coating materials, including dried or cured films. A unique feature of this "spot" test is that no reagent is employed, other than the cellulose of the filter paper on which the test is observed.

191. SYMPOSIUM ON CASTING RESINS.
WASHINGTON, D. C., 24–25 JAN 1956.
Diamond Ordnance Fuze Laboratories,
Washington, D. C. ASTIA AD-102 048.
26 Jan 1956. 365p.

Contents:

Encapsulating techniques for electronic equipment
Protective potting of glass vacuum tubes and ceramic components
Problems encountered in the development of potted electronic devices for a specific ordnance application; a case history
Casting resin investigations at Naval Ordnance Plant
Elastomeric potting compounds for aircraft electrical connectors
Machines and techniques for applying multi-constituent casting resins
The cast plastic sealing of platinum-clad anodes for cathodic protection of submarine hulls
Polysulfide liquid polymer and modified epoxy resin casting compounds
Potting resins, functions and requirements
Polyurethane potting resins
Curing resins suitable for embedding electronic components
Epoxy-polybutadoene resins
Curing resins suitable for embedding electronic components
Epoxy-polybutadoene resins
A preliminary survey of the properties of commercial plastisols and primers for plastisols
The control of chemical and physical factors in the application of casting resins
Thermal properties of encapsulating materials
The effect of thermal shock on the shape and adhesion of various commercial compounds
Dielectric properties of several casting resins
The effects of outdoor weather aging on encapsulating materials
Corrosive effects of casting resins on bare copper wire

192. Thomas, H. L. and J. W. Guyer
Toxicology of aliphatic amine curing agents in epoxy tooling systems. In TECHNICAL PAPERS, SEVENTEENTH ANNUAL TECHNICAL CONFERENCE, WASHINGTON, D. C., JAN 1961. Washington, D. C., Society of Plastics Engineers, Inc., Baltimore-Washington Section, 1961. v.7, Sect. 13-1.

193. Tomak, R. E.
Thermal aspects of welded-encapsulated packaging. In WELDED ELECTRONICS PACKAGING, FIFTH SYMPOSIUM, SUNNYVALE, CALIF., 21 AUG 1961. Sunnyvale, Calif., Lockheed Missiles and Space Division. Stanford, Calif., Stanford U. Pr., 1961. 14p.

Within the scope of packaging commercially available components, the designer had long been faced with the inconsistency between unwieldy components and optimum use of available packaging space. A relatively new approach which, in effect, tailors unwieldy components into more consistent form factors is made possible by three dimensional packaging. This method of packaging requires rigidization of the 3-D component structure and, as such, the selection of a throw away level. This paper presents directional information regarding the thermal characteristics of various types, techniques, and secondary considerations associated with the encapsulation of electronic circuitry. The data, when viewed in light of packaging goals, allows the designer to preview the possibilities of an optimized encapsulation approach based on thermal reliability considerations.

194. Tucker, R., J. Cooperman and P. Franklin
Dielectric properties of several casting resins. In SYMPOSIUM ON CASTING RESINS, WASHINGTON, D. C., 24-25 JAN 1956. Diamond Ordnance Fuze Laboratories, Washington, D. C. ASTIA AD-102 048. 1956. p.294. (Also in: ELECTRONIC EQUIPMENT, Jul 1956.)

195. Turner, F. M.
MEMORANDUM ON THE HAZARDS AND HANDLING OF EPOXIDE RESIN SYSTEMS.
Atomic Energy Research Establishment, Gt. Brit. AERE rept. no. MED/M 27; HL 58/2561. Oct 1958. 7p.
ASTIA AD-208 780.

Cases are described which show that materials used in the production of epoxide-resin-polyamine systems can give rise to dermatitis. This can be attributed in most cases to the hardeners or curing agents – i.e., polyamines, but cases of reaction to the uncured resins have also reported and a few isolated cases of reaction towards the cured resin. Hypersensitivity of the skin to these materials may develop in some subjects, necessitating their transfer to other types of work. Animal experiments are mentioned which suggest that toxicity of the resins is relatively low, the polyamines being considerably more toxic and irritant than the uncured resins, which vary in toxicity. The cured resins under test appear to be innocuous. Method handling and personal protection which have proved satisfactory are described.

196. TECHNICAL DATA COMPILATION ON 100% SOLIDS URETHANE MATERIALS. Mobay Chemical Co. Technical Bulletin, 1960.

197. URETHANE ELASTOMER POTTING COMPOUNDS.
Mobay Chemical Co. Technical Bulletin, No. G-2, 1959.

198. Volk, M. C.
Encapsulation systems for electronic components.
RADIO AND ELECTRONIC COMPONENTS 2:662–668, Sep 1962.

The plastics industry is meeting the challenge of component engineering in the field of speciality dielectrics and improved application techniques.

199. Walker, J. R. and M. Frank
DESIGN METHODS FOR MAGNETIC AMPLIFIERS AND SATURABLE REACTORS. Wayne Engineering Research Inst., Detroit, Michigan. Rept. no. WADC-TR-56-281, 22 May 1956. 628p; Supplement 1. 4 Mar 1957. 63p.

Information is included on encapsulating and potting materials.

200. Walter, M.
Aging of plastics. PENSEZ PLASTIQUES 87:86, Sep 1960. (In French)

A critical discussion is made of natural and artificial aging methods, an evaluation of the results of these methods, and of the types of aging equipment. A description is given of a four-chambered installation designed for testing under a wide range of temperatures (-40°C to 200°C); exposure to radiation (infra-red and ultraviolet); humidity (0 to 100%); salt water mists; and destructive gases.

201. Warburton, J. A. and R. S. Norman
High temperature epoxide resin formulations. In APPLICATION OF ELECTRICAL INSULATION, THIRD ANNUAL CONFERENCE, CHICAGO, ILL., DEC 1960. Chicago, American Institute of Electrical Engineers and National Electrical Manufacturers Association, 1961. p.46.

202. Warfield, R. W., P. Erickson and I. Silver
POTTING STUDIES ON DUPONT ENCAPSULATING RESIN 820-001 INCLUDING THE USE OF A CONTINUOUS CURRENT MONITORING DEVICE FOR MEASURING ELECTRICAL PROPERTIES
Naval Ordnance Lab., White Oak, Md.
Rept. no. 1, NAVORD rept. no. 4208, 12 Jan 1956.
12p. ASTIA AD-87 630.

A survey of the progress to date on the potting program is given. This includes a short description of the continuous current monitoring instrumentation which has been developed for this program. The direction of future work is outlined. A commercial resin (Dupont 820-001) has been evaluated and detailed studies have been made of its handling, curing and electrical properties. Cure conditions have been found which give a minimum of locked-in stresses and optimum electrical properties. This curing cycle eliminates both the sudden gelation and the high rate of polymerization which usually imparts poor physical properties to the casting. General recommendations for the preparation of castings from this resin are presented.

203. Warfield, R. W. and M. C. Petree
A STUDY OF THE POLYMERIZATION OF THERMOSETTING POLYMERS BY ELECTRICAL RESISTIVITY TECHNIQUES. Naval Ordnance Lab., White Oak, Md. NAVORD rept. no. 6702, Aug 1959.

204. Wavgaman, C. A. and G. B. Jennings
Properties and applications of three new estane thermosetting polyurethanes. In PROCEEDINGS OF THE DIVISION OF PAINT, PLASTICS, AND PRINTING INK CHEMISTRY, 137TH ACS MEETING, CLEVELAND, OHIO, 5–14 APR 1960. Washington, D. C., The American Chemical Society, 1960. v. 20, p.230.

205. Weinert, H.
The effect of atmospheric humidity on the surface resistance of plastics. PLASTE U. KAUTSCHUK 7:480, Oct 1960. (In German)

The surface resistance of plastics under high humidity is shown to be far below the values given in the literature. The author feels that the insulations should be tested under the conditions in which they are to be used. Graphs are given which illustrate the relation of surface resistance to relative humidity.

206. Wilkinson, R. L.
A STUDY OF CASTING RESINS FOR MILITARY APPLICATIONS. Canadian Army Signals Engineering Establishment. Engineering memo no. 15. 17 Jul 1956. 14p. ASTIA AD-146 226.

207. Wilson, D., J. Cairns and L. G. Rado
EVALUATION OF THE LIBRASCOPE AEROSPACE BRANCH (SAN MARCOS) LAMINATED PRINTED BOARD PROCESS. Librascope Div., General Precision, Inc., Glendale, Calif. Rept. no. 1-0675. 25 Jan 1962. 13p. (IDEP rept. no. 141.10.50. 10-S1-05). ASTIA AD-273 373.

Tests were made to evaluate a new laminated printed board process. Eight boards were fabricated for this experiment. The fabrication basematerial was epoxyglass G-10 and bonded with epoxy (Shell 820). The process was evaluated in thermal shock and vibration. No shortcomings were discovered during and after environmental testing.

208. Wilson, L. T.
Resilient cushioning materials. Sandia Corporation, Albuquerque, N. M., Technical memo no. 35-59(12). Feb 1959.

209. Wynstra, J., et al.
Structure versus elevated temperature performance of epoxy resins. MODERN PLASTICS 37(9):131–136, 190, May 1960.

Discussion of tests which were conducted to find out if resins with a higher functionality than the bispherol A and epichlorohydrin type will significantly raise the service temperature of laminates. Curing agents are also discussed.

210. Wynstra, J.
Flexible polyester/liquid epoxy resin condensates. In PROCEEDINGS OF THE DIVISION OF ORGANIC COATINGS AND PLASTICS CHEMISTRY, 138TH ACS MEETING, NEW YORK, 11–16 SEP 1960. Washington, D. C., The American Chemical Society, 1960. v. 20, p. 45.

211. Young, R. P.
AN EXAMINATION OF EPOXY SYSTEMS USEFUL IN PACKAGING HIGH G RADIO TELEMETERS. Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Rept. no. AEDC TDR 62-58. Mar 1962. 24p. ASTIA AD-273 681.

The electrical components used in high g (500,000 g) telemetry packages will survive gun launchings only if potted in suitable materials. The materials considered for this application were: polyesters, epoxies, silicones, phenolics, and urethanes. The epoxy materials appeared to fulfill most of the requirements for this application. This report described epoxy materials, their curing, methods of potting, and the tests performed to select an epoxy material for embedding telemetry packages launched from hyper-velocity guns in aeroballistic ranges.

CORPORATE AUTHOR INDEX

SECONDARY AUTHOR INDEX

SUBJECT INDEX